

## A KARYO-SYSTEMATIC STUDY OF ROBINIA

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*With one text figure*

THE GENUS *Robinia* contains about 20 species, and has a strictly North American distribution. Furthermore, it is practically confined to the continental United States; only one species has been recorded from territory outside of this area. An interesting feature about the distribution of this genus is the parallel course it runs east and west of the continent. Thirteen species are found in the Appalachian Mountains from Pennsylvania southward to Georgia and Alabama, and five species are found in the Rocky Mountains from Colorado to as far south as the Mexican border (Rydberg, 1924).

As one of the steps necessary in supplying a biological background for a systematic study of the genus, a karyological investigation has been undertaken of the species of *Robinia* in the collections of the Arnold Arboretum. Although this collection is by no means complete, it contains representatives of each series of the genus, and from this point of view the species examined furnish a general survey of the karyological conditions in *Robinia*. A brief report of the karyological observations and comments on their systematic significance follow.

## OBSERVATIONS

*Robinia* is decidedly not ideal material for karyological studies. The chromosomes are small, and in aceto-carminic smears the differentiation between chromatin and cytoplasm is not particularly sharp. Heating does not alleviate this condition as it does with some material. The chromosome counts were secured from aceto-carminic, and in some cases permanent smears. In Table I the chromosome number and percentage of pollen sterility are recorded for the species that were investigated.

## Ser. PSEUDOACACIAE and NEO-MEXICANAE

Tschechow (1930) has published a figure (from mitosis in a root-tip cell) in which *Robinia Pseudoacacia* is shown to have 22 chromosomes. Kreuter (1930) has found 10 chromosomes at meiosis in this species. The present writer did not have material available for study, but from indirect evidence, one is forced to the conclusion that there must be 10 pairs of chromosomes in this species. This conclusion is based on the observations of meiosis in spontaneous hybrids where *R. Pseudoacacia*



was reputedly one of the parents; i. e. *R. Holdtii*, *R. Slavinii*, *R. Margareta*. Since the other supposed parent in most cases has 10 pairs of chromosomes, with normal pairing taking place, the evidence favors the view of Kreuter that *R. Pseudoacacia* has 10 pairs of chromosomes.

TABLE I

	Species	Chromosome number (n)	% of pollen sterility
I. PSEUDOACACIAE	<i>R. Pseudoacacia</i> L.	*10	25
	<i>R. Holdtii</i> Beissn.	10	16
	( <i>R. Pseudoacacia</i> × <i>R. luxurians</i> )		
	<i>R. fertilis</i> Ashe	10	19
	<i>R. Kelseyi</i> Hutchins.	10	10
II. HISPIDAE	<i>R. hispida</i> L.	15	88
	<i>R. Boyntonii</i> Ashe	15	72
	<i>R. Slavinii</i> Rehd.	10	48
	( <i>R. Kelseyi</i> × <i>R. Pseudoacacia</i> )		
III. NEO-MEXICANAE	<i>R. Margareta</i> Ashe	10	30
	( <i>R. hispida</i> × <i>R. Pseudoacacia</i> )		
IV. VISCOSAE	<i>R. luxurians</i> Schneid.	10	25
	<i>R. viscosa</i> Vent.	10	45
	<i>R. Hartwigii</i> Koehne	10	10

\*From Kreuter (1930)

*Robinia Holdtii* (*R. Pseudoacacia* × *R. luxurians*) has 10 pairs of chromosomes (Fig. 1). Pairing seems to be normal; the percentage of good pollen is slightly higher than that produced by either parent. Aside from its morphological characteristics, which are intermediate between the parent species, it has few of the attributes of a hybrid.

The only western species of *Robinia* studied, *R. luxurians* has 10 pairs of chromosomes (Fig. 2). Karyologically, it is similar to the diploid eastern species. The plants of *R. luxurians* were labeled as *R. neo-mexicana*. This is undoubtedly an error. As Sargent (1921) and, later, Rehder (1927) have pointed out, *R. neo-mexicana* has probably never been brought under cultivation, and would not be hardy if it were.

#### Ser. HISPIDAE

In the Hispidae, *Robinia fertilis* and *R. Kelseyi* are apparently two of the basic diploid species (Fig. 3). Each species has 10 pairs of chromosomes, meiosis is regular in both species. The percentage of good pollen is relatively high and an abundance of pods is developed.

Meiosis in *Robinia hispida* and *R. Boyntonii* is very irregular (Figs. 4 & 5). This is to be expected as both are triploids. What appear to be



multivalent associations and univalents have been found at meiosis in both species. The low percentage of good pollen is a further indication that meiosis is irregular. Biologically, all of the plants of *R. hispida* in cultivation must represent a clon, since this species very infrequently produces seed pods, and since it is propagated exclusively by vegetative means. From the fact that tetraploids have thus far never been found

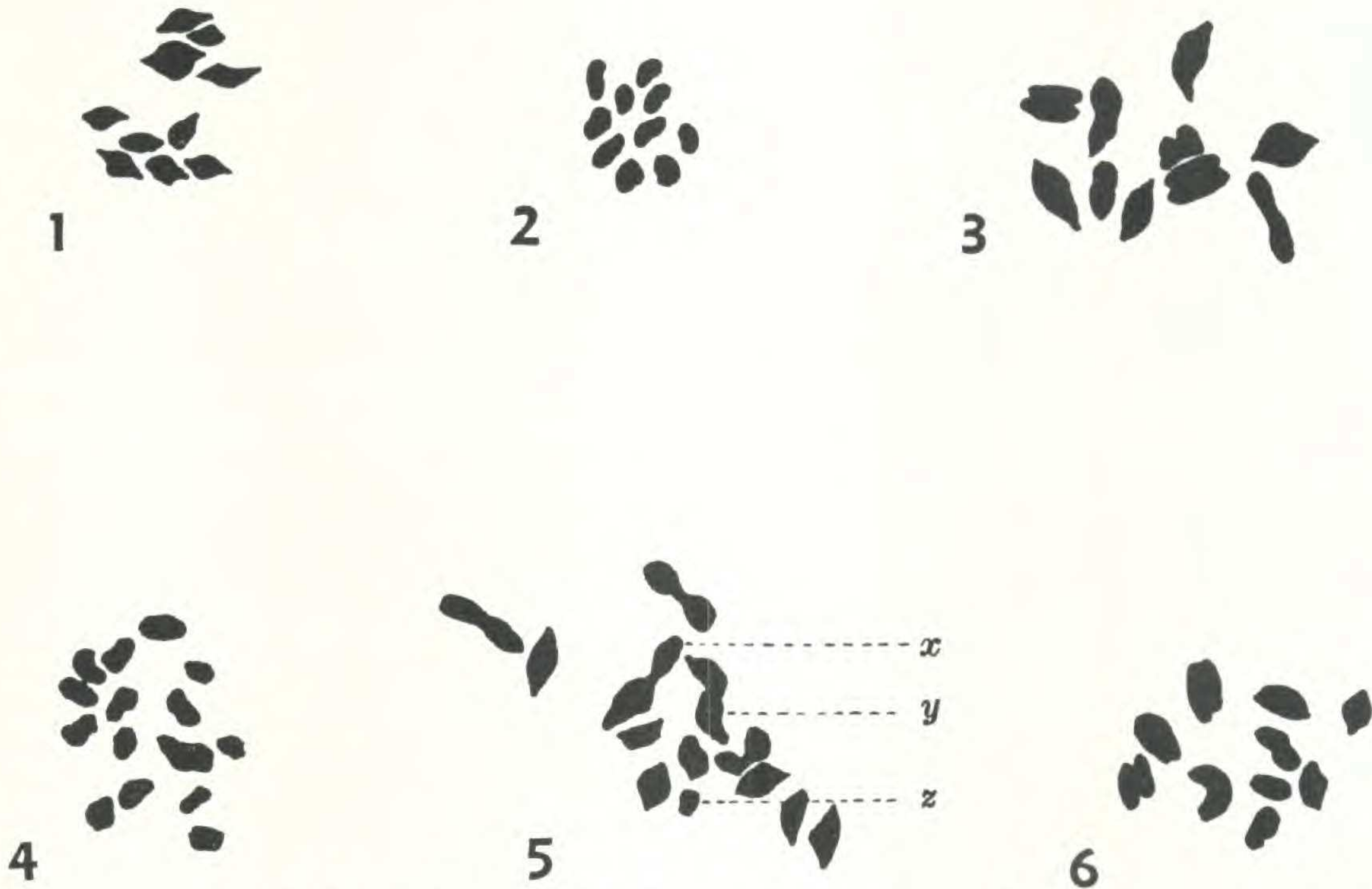


FIGURE 1. *Robinia Holdtii*, 10 chromosomes. FIG. 2. *R. luxurians*, 10 chromosomes. FIG. 3. *R. Kelseyi*, 10 chromosomes. FIG. 4. *R. hispida*, 10 chromosomes. FIG. 5. *R. Boyntonii*, 15 chromosomes, x and y = trivalents, z = univalent. FIG. 6. *R. Hartwigii*, 10 chromosomes. All drawings were made from first metaphase plates. Magnification: Figures 1, 2 and 4  $\times$  2100, 3, 5 and 6  $\times$  2500.

in *Robinia*, presumably the triploids have originated from one of the diploid species, either from an unreduced egg cell or from the fertilization of a haploid egg by a diploid pollen grain (Darlington, 1932). It seems unnecessary to assume, as Kreuter (1930) has done, that *R. hispida* is a hybrid.

Taxonomically *Robinia hispida* and *R. Boyntonii* are more closely allied to *R. fertilis* than they are to other members of the Hispidae. It is very likely that these triploid species may have originated from *R. fertilis*. The case for *R. hispida* in this respect is rather good. In many of its characters *R. hispida* bears a close resemblance to *R. fertilis*.

A spontaneous hybrid between *Robinia Kelseyi* and *R. Pseudoacacia*



has recently occurred under cultivation (Rehder, 1921). This hybrid, *R. Slavinii*, has 10 pairs of chromosomes. The pollen fertility is fairly high, and it sets a moderate crop of seed pods. Pairing seems to be normal. No meiotic irregularities were observed.

*Robinia Margaretta* is a reputed hybrid between *R. hispida* and *R. Pseudoacacia*. It has many of the characteristics of *R. Pseudoacacia*, and it is quite likely that the latter species may have been one of the parents. It is doubtful whether *R. hispida* could possibly have been the other parent because of its triploid nature. On the other hand, it is quite probable that *R. fertilis* may have been one of the parents. In *R. Margaretta* meiosis was regular. Pollen sterility was as high as 30%, but the plants fruited freely.

#### Ser. VISCOSAE

Meiosis in *Robinia viscosa* seems to be regular, although there is considerable pollen sterility. This species sets seeds very sparingly. Professor Rehder of the Arnold Arboretum has informed me that in some cases, trees of this species do not set any seed, indicating that in such instances pollen sterility must be much greater or that possibly the plants are self-sterile.

The two species included under the Viscosae (*R. viscosa* and *R. Hartwigii*) are very closely related. Karyologically they are similar (Fig. 6). Of the two, the percentage of good pollen is much larger in *R. Hartwigii*. This probably accounts for the fact that it sets seed in greater abundance.

#### DISCUSSION

The occurrence of a large number of fertile spontaneous hybrids between the various species of *Robinia* is understandable in the light of the karyological situation shown to exist in the genus. Since a majority of the species are diploids and perfect pairing exists between the hybrids investigated, most of them should hybridize readily whenever opportunity is afforded. Another point of some interest, in this connection, is that the diploid species occur in the Appalachian and on both sides of the continent and apparently hybridize quite easily. *Robinia Holdtii*, a reputed spontaneous hybrid between *R. Pseudoacacia* and *R. luxurians*, may be cited as an example. From the literature it is evident that several cases of this cross have occurred.

Kreuter (1930) and Tschchow (1930) have made extensive karyological investigations of the Tribe Galegeae. Basic numbers of 8, 10, 15, and 24 have been found. The basic number seems to be relatively constant within the genus in this tribe. There is no indication of a karyological relationship between *Robinia* and other members of the



Galegeae. *Amorpha* has a basic number of 10, but the chromosome morphology is distinctly different from that of *Robinia*.

*Robinia* is one of those genera in which polyploids and hybrids, even though they may be sterile, are factors to be reckoned with in speciation because of the fact that these forms are propagated very readily and rapidly by vegetative means, and are thus able to maintain themselves.

#### SUMMARY

The basic chromosome number in *Robinia* is 10. *Robinia hispida* and *R. Boyntonii* are triploids. These species are maintained by vegetative means. The chromosomes in all of the hybrids exhibited complete compatibility. This is true of the hybrids between the eastern and western species of the genus, which have been separated by considerable periods of geologic time.

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